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Twenty years ago during my residency in Germany, I was taught to treat trapeziometacarpal (TMC) joint osteoarthritis using the following algorithm: when conservative treatment with hand therapy and splinting failed to relieve the patients' complaints and there were restrictions in everyday life due to pain of the TMC joint of the thumb, surgery was indicated. Regarding the choice of surgical procedures, the mainstay was resection of the trapezium with a suspension with a distally based strip of the flexor carpi radialis (FCR) tendon, as described by Epping and Noack (1983) in German journals. This algorithm was the set choice in the department as well as in many others in and outside Germany. There were many variations in using tendons in close anatomical proximity to the base of the thumb metacarpal bone in suspension arthroplasty (Brunelli et al., 1989; Weilby, 1988); the choice was made by the chairman of the department in Germany, based on his experience and preference.

My learning and understanding on the treatment 20 years ago

Besides the learning from my mentors, I also learned from books that the basic options were the following: the resection of the trapezium alone or resection and suspension with a tendon strip. Alternatively, it could also be a tendon interposition or combination of the suspension and the interposition. Epping and Noack (1983) described suspension of the first metacarpal after resection of the trapezium in German. I learned to do a suspension–interposition arthroplasty according to an article published in English (Burton and Pellegrini, 1986).

As a resident, I asked my mentors, the consultants, the reason for using one specific technique as opposed to others. To my recollection their major points were as follows. The main argument for choosing this operative approach was that if there are different options, namely suspension, interposition, or a combination of both, to stabilize the first

metacarpal and prevent proximalization after the resection of the trapezium, it must be the best option to combine these approaches in order to prevent proximalization as this was considered the main reason for failure of the procedure.

Obviously, at that time surgeons were not guided as much by evidence as we are today. Neither did patient-reported outcomes nor randomized controlled clinical trials play an important role in their decision-making. This does not mean that the surgeons did not care for the patients' outcome at that time. Rather, the surgeons generally thought that the longer and more complicated operation would lead to the best possible results for the patients, and they aimed to restore stability of the first metacarpal after the resection of the trapezium. The drawback of this reasoning could be an increased risk of complications due to the more extended operative approach with tendon harvesting and drilling through the base of the first metacarpal. This could lead to complications as serious as median nerve injury while using a tendon stripper, in an effort to avoid extensive scarring, to harvest the FCR tendon strip. Apparently, during my training period the choice of the surgical method was mainly influenced by authority bias within the department.

In my later training period, for example during fellowships or visits to foreign colleagues, I realized that there were many different factors that could influence the choice of a surgical method, such as countries or geographic regions and the departments where the hand surgeon had been trained. Financial bias may also play a role. The use of TMC joint prostheses, for example, seemed to be mainly influenced by the reimbursement of the implant and the operation by the insurance companies in various countries. TMC joint prostheses were used to a much greater extent in countries where these procedures were paid for, as opposed to almost no use of TMC joint prostheses in other countries where the price paid by the insurance companies for the whole procedure did not even cover the cost of the prosthesis itself.

The changes in my practice as a consultant in the Netherlands

Later in my career as a consultant in the Netherlands I found that the influence here was more from English language literature. At that time the Cochrane Review for 'Surgery for thumb (trapezio-metacarpal joint) osteoarthritis' (Wajon et al., 2005) had been published. Based on the results of this there was a strong tendency towards simple trapezectomy, without any tendon interposition or suspension. Many experienced hand surgeons, with decades of clinical practice, later told me that they had tried simple trapezectomy for a while in their clinical practice based on the results of this Cochrane Review, but had resumed a suspension technique, at least with a partial tendon strip, based on their personal experience (impression) that simple trapezectomy had inferior results. Unfortunately, none of them had published on this or was able to provide data in this regard.

To me the reason might be that the incidence of complications differs depending on the experience of the hand surgeon, which may also have an influence on the result of the procedure itself. Therefore, we encourage authors to report the level of experience of the surgeons in their studies (Tang and Giddins, 2016).

A major issue with surgical treatment of TMC joint osteoarthritis and its evaluation is the variety of techniques that are available. This does not only comprise resection with or without tendon suspension and/or interposition, arthrodesis, or prostheses, but operation details of individual surgeons. Here are a few examples: the resection of the trapezium can be complete or partial, each of which could be done arthroscopically. For tendon interposition, the choices include FCR, abductor pollicis brevis, extensor carpi radialis longus, palmaris longus, and artificial tendons substitutes, which introduce new areas for errors or complications. The same goes for the multiple TMC joint prostheses that are available and for which long-term follow-up is essential (Tang et al., 2019). From a surgical point of view, we need reliable long-term results of TMC joint prosthesis in order to put these therapeutic options into perspective and compare them with resection arthroplasty. Recently more long-term results have been published in this regard (Bellemère, 2019; Smeraglia et al., 2020). Furthermore, different emphasis in the evaluation of the results of TMC joint surgery have to be taken into account (Tsehaie et al., 2019).

Additional details of the operation, such as skin incision and approach to the joint (palmar, dorsal, or radial) might have an important influence on the

results, which is not apparent from available data. We need to be meticulous in our reporting of operative details as well as in evaluating our results. This thought should be implemented into teaching of hand surgeons. Hopefully, (inter)national cooperation and research will help to obtain more definite answers that will enable us to choose the best operative method for TMC joint arthritis.

Currently, I use a palmar approach with a skin incision that lies within the relaxed skin tension lines. I push the thenar muscles aside in a 90° angle to this without any disruption of the muscle fibres before opening the joint capsule, which makes a resection of the trapezium in one piece possible in most cases. The distal branches of the superficial branch of the radial nerve are much less at risk from this approach as opposed to a radial or dorsal one. Then a distally based strip of the FCR or abductor pollicis longus tendon is used for a suspension below the base of the first metacarpal without any drilling through this bone. I base this choice on the tendon thickness and position, which means that I use the one that is easier to harvest. If both tendons are thin, strips of both can be used. No extra incision is needed for this technique of tendon harvesting. Only in extreme cases of long-standing Z-deformity of the thumb, more extended tendon plasties are indicated.

The current treatments in Germany

Recently results of multiple techniques to treat TMC joint arthrosis have been reported in the German literature, including distraction arthroplasty according to Bufalini and Perugia (Fatzer et al., 2015), Swanson's trapezium implant arthroplasty (Zschöck-Holle et al., 2015), and trapezectomy and suspension with an artificial rope (Szalay et al., 2014). This might depict publication bias as the most often used surgical method and overall reference standard is still trapezectomy, whose results are difficult to publish presently given that the technique is no longer new. Thus the different modifications regarding suspension or interposition with capsular tissue or tendon strips actually used are difficult to quantify. In addition, new treatment options, like lipofilling, have been explored (Herold et al., 2017), but these have been prohibited by the regulatory authorities as they are considered to be subject to the German Pharmaceuticals Act (Ruettermann, 2019; Sanzenbacher and Frech, 2019).

Clearly publications on this common disorder provide evidence to guide our clinical practice. The evidence is accumulating, such as those reported in this issue. My personal view is that there will be a choice or range of procedures in our toolbox, of which we

will have to choose the right one for the individual patient, *based on evidence for each of these procedures* that tells us what the advantages and disadvantages of each additional step of this procedure are. It is likely that one operative method for all cases of advanced osteoarthritis of the TMC joint might not be appropriate for all patients' hands.

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